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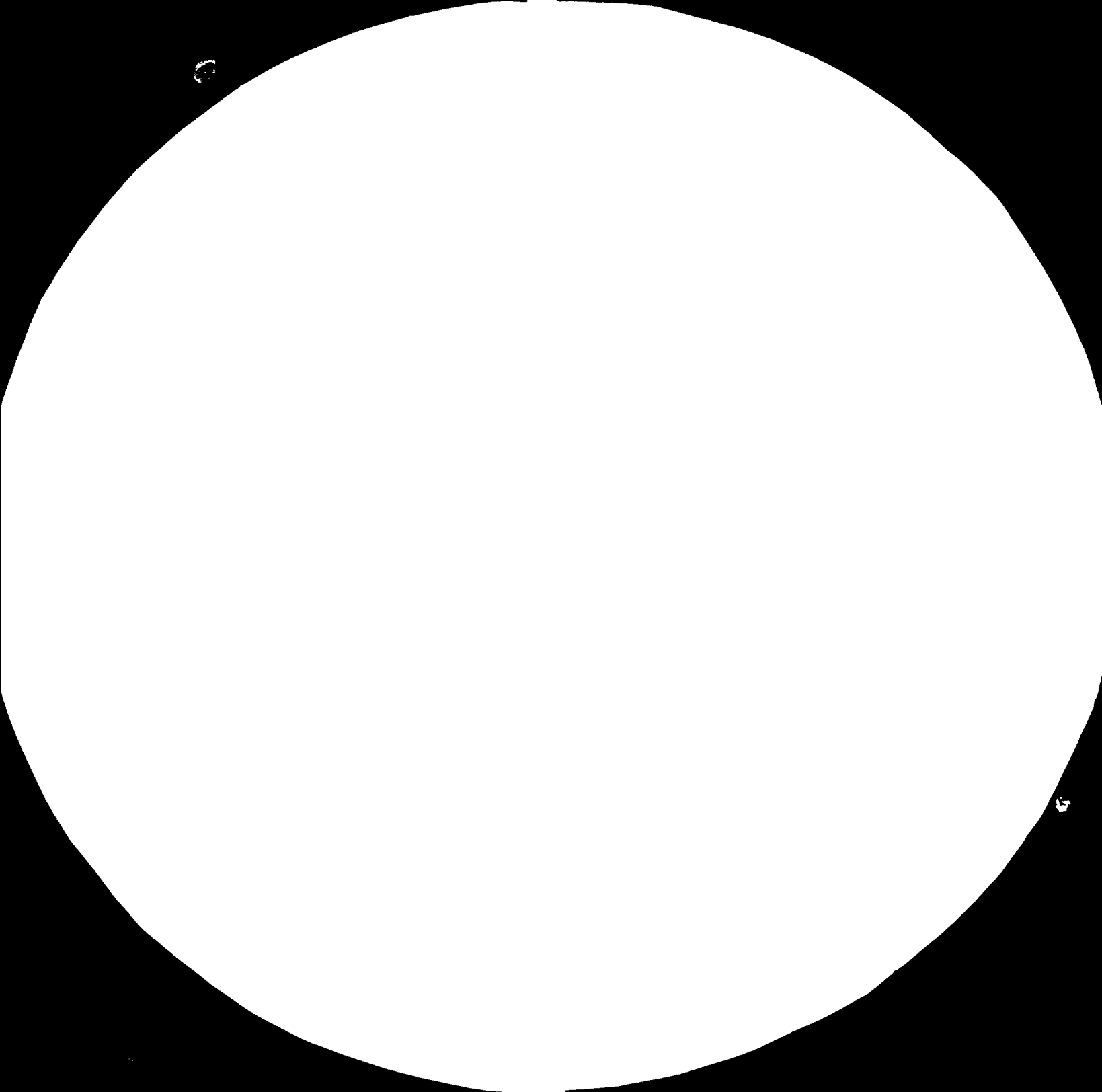
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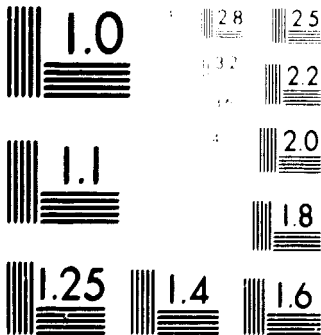
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ASSISTANCE IN THE ESTABLISHMENT OF A LABORATORY AND
PILOT PLANT FOR PROTECTIVE METAL COATINGS

SI/CUB/81/804

CUBA

Terminal report*

Prepared for the Government of Cuba
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme.

Based on the work of Z.J. Kolanko

expert in electroplating

United Nations Industrial Development Organization
Vienna

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ABSTRACT

Title of the project:

Assistance in the Establishment of a Laboratory and Pilot Plant for Protective Coatings (No. SI/CUB/81/804).

Purpose of the project:

Centre for training and demonstrations, based on modern technologies.

Duties and duration of expert's mission:

To assist in putting the plant into operation, training of counterparts; three months, as per job description. The purpose of the project and the mission were in complete accordance.

The workers of the pilot plant were trained theoretically (elementary) and practically in the range of principal non-cyanide baths (bright nickel, copper, chromium and zinc plating baths), which were introduced on the basis of brighteners received from Poland.

Specifications were made of indispensable materials for current work of the plant and the terms and conditions were given so that it will be possible to introduce cyanide baths in CIME.

The expert's recommendations were given for introduction of technologies in agreement with the project and for normal, current works in the pilot plant for the following:-

- Government's priority for 2-3 years for this project;
- six months for putting in order all arrears;
- teaching/training of 2-3 persons from CIME in cyanide problems in other countries;
- introduction of cyanide baths to the end of 1984.

The problems of the electroplating pilot plant were (based on this report) submitted to the V.Min. Mr. Juan P. Vázquez (Min. of Metallurgy and Mechanics) for consideration and for taking of appropriate effective decisions.

The UNIDO Expert Prof. Dr. Tadeusz Zak was in Cuba between November 1971 and October 1972 as an expert on protective anticorrosion coatings. He was acquainted with the results of the corrosion in the industrial plants in Cuba, (Metallurgy, Mechanical, Chemical, Sugar and others).

In his final report on completion of his mission he stated that due to Cuba's hot humid climate and salinity of air in coastal areas, the problems of corrosion of industrial and maritime installations are particularly apparent and that it has been stated that in Cuba there are very little studies conducted on the corrosion of industrial installations and practically no engineers or technicians dealing with corrosion protection.

To improve the existing situation it will be necessary to strengthen the newly created department of corrosion protection, at the Centro de Investigaciones Químicas (CIQ) in Havana"

He also stated that one of the principal activities of this Centre ought to be the organization of the laboratory for electroplating, to introduce to the Cuban industry modern, technological electroplating methods and specialized pilot plant for training and demonstration. The design of such a laboratory has been made and the equipment selected. It is to be hoped, that this laboratory will enter into operation in 1973. Parallel ought to be organized a pilot plant for neutralization of metal finishing effluents (design) e.g. from electroplating. The design of it is just completed and discussed. The plant will be built in 1973.

According to the recommendations which were given in the report of Prof. T. Zak, the above given propositions were inserted to the preliminary project plan for 1972 and also to the five years plan 1972/76; there were gathered in CIQ the equipment and materials for use for this purpose as well as Government and UNIDO funds and Polish help (delivery of some chemicals, two electronic apparatus for measuring of thickness of the coatings, preliminary teaching in IMP of 8 Cuban engineers and technicians from CIQ in different kinds of protective coatings - also electro plating.

Meanwhile, on the suggestion of the Cuban Government (1976) the problems of electroplating coverings and electroplating effluents were discussed with the Centro de Investigaciones Metalurgicas (CIME). On the strength of this decision some equipment was installed for common investigations and also materials relating to the above to assist in training the workers in CIQ in solving these problems.

In May 1976, CIQ despatched part of the equipment to CIME. However, it proved impossible to determine the overall level of investment or its sources, on account of their variety of financing and distribution during the change from CIQ to CIME.

Starting from 1976 the investment tasks of electroplating pilot plant were taken over by CIME and with UNIDO assistance. (Projects: DP/CUB/72/005, SIS/CUB/75/802, DP/CUB/79/007, SI/CUB/81/804). There were separated and partially adapted spaces for the electroplating pilot plant and laboratory as well as provisional isolated hand-magazine for cyanides; neutralization chambers were built for electroplating effluents (without equipment) and an exhaustion system assembled.

UNIDO supplied a considerable part of the equipment for the electroplating pilot plant (app. 1), coulometric thickness-meter for measuring of coatings thickness, apparatus to the measuring of internal stresses in metal coatings, laboratory balance and some others.

The amount of funds given by UNIDO and the Cuban Government for the above are also given in app. 1.

In 1978 UNIDO's Expert assisted the CIME in starting the pilot plant during his assignment period. The purpose and duties of his "preparatory mission" were outlined in the job description for a two week period. A report on the results of the mission was forwarded to UNIDO with recommendations for possible future assistance to the CIME.

With a proposition of a second mission at the request from the Government of Cuba, UNIDO offered its expert, Mr. Kolanko, a three month assignment to assist the CIME in installation of equipment for the pilot plant.

I. PRESENT STATUS (on 18.XI.1982)

During the expert's assignment he devoted many days to be acquainted with the present state of the electroplating pilot plant at the beginning of his mission.

It was found, that some technologies (copper, nickel, chromium, zinc - plating, the last with passivation) were introduced in the scope of CIME from February 1981. These technologies are not modern and must be treated as somewhat outdated. They were used without proper neutralization of effluents.

The technical state of the pilot plant with regard to investment, provision of equipment, materials, reagents, auxiliary tools and others were examined in detail.

After ascertainment of lacking in very essential documentation, investment, equipment and execution of installations in the plant, the expert prepared a short information on this theme with a working schedule (app.3), which was sent to UNIDO Headquarters, Vienna with a proposition of partial change of the expert's job description.

Included in this working schedule also is an explanation on the introduction of cyanide baths which is required by CIME for this project.

In spite of a lack of these baths at present their necessity is discussed and explained in this report.

According to the prepared working schedule (app.3 p.III A,B), the following action was carried out:

- Theoretical training of personnel of the electroplating department in CIME in the electroplating problems;
- Arrangement and practical training and an introduction about the new baths in the pilot plant;
- Introduction of the new bright Ni/Cu/Cr and Zn plating baths to the current production in the installed equipment in CIME;

II. LACKS IN THE EQUIPMENT OF THE PILOT PLANT

The observed investment lacking and careless montage of installations may be divided into various aspects:

- 1. Limiting the normal, continual work of the pilot plant;
2. Making normal work difficult or a danger in the future;
3. Impossible to purchase in the future;

A. LACKS LIMITING THE NORMAL CONTINUAL WORK OF THE PLANT

1. Lack of full documentation for the pilot plant as well as for the built but unable to use neutralizator. In both cases there are only fragmentary drawings and sketches not supported with essential calculations. The primary plan of effluents, neutralization from tanks installed over the earth was changed; the tanks were used for another purpose.
2. Lack of neutralizator of effluents or stable substitute solution is a principal lack, limiting all normal, continual work of the plant. This problem, although it was mentioned in the first place in recommendations five years ago (app.2 p.4A) was not solved. Works were begun giving effluents without proper neutralization, as a result of which on 13.12.82 all work had to be stopped in the CIME.

The lack of neutralizers forced the expert to conduct all his training in a limited range by periodic gathering of neutralizers in small containers for neutralization of effluents. This was an unnecessary time and labour consuming work and is not acceptable as a permanent solution to the problem.

The expert's propositions for solving this problem are given in app.3 p.II 3 and 4.

The effluents installation inside the plant does not guarantee continuous flow of individual or different effluents, without mixing them. It may be, in the presence of cyanide baths in the future very dangerous for all the environment, specially for the plant workers.

The problems of neutralizer and effluents installation inside the pilot plant requires parallel solution by taking on a general decision about the method and equipment for effluents neutralization. It must be also taken into consideration the building of 10-15 cms. high beton thresholds between individual lines of effluents. The task of these thresholds is to stop the mixing of different kinds of effluents (e.g. from cyanide and acid baths) during damages, e.g. by breaking of glass balloon or after unvisible corrosion of bath-tank.

The building of a neutralization system ought to be done based on full technical documentation.

3. Lack of proper magazine for cyanides. It limits their purchase and introduction of technologies on their base. According to the decision of CIME Director, there were not any cyanides in magazines available. The proper specifications for cyanides and other principal materials (including 46 positions) were made and given to the Director on 10 and 17.12.82. These materials ought to be stored in a proper magazine for cyanides, etc. and used only for the electroplating plant.

4. Provision of materials. Relatively good works were prepared for the electroplating plant's laboratory; excepting for silver sulphate (Ag_2SO_4) no lack of other materials were stated. Reserves of necessary analytical reagents and laboratory glass were properly kept and analysis were made precisely and as quickly as was possible.

Due to the indecision from which country the brighteners should be bought for the new baths, it may stop the production after a run of 5 liter specimens which were devliered non-refundable from IMP in Poland. Contracts for purchase of the brightners should be made as soon as possible for a change

of brighteners requires the regeneration of proper baths.

To add to the difficulties, no reserves of chemicals such as acids, (e.g. HCl , H_2SO_4) were made, which are normal technical chemicals used for degreasing baths (Na_3PO_4), etc.

The materials which were necessary for the pilot plant were very often fetched from another industrial or scientific institution already after the work had begun (HCl , H_2SO_4 ; Na_3PO_4 , $\text{K}_2\text{S}_2\text{F}_6$, brass-plates,) but many times it was not possible to use these chemicals (e.g. technical HCl with great amount of grease). This delayed the introduction of intended new technologies.

It is only due to extraordinary operative activity of V-Director of CIME, Mrs. Osmara Ortiz and the plant's personnel, that some of the required material reached the plant, sometimes even after its start.

It can be said that due to the lack of materials work was limited.

5. Exhaustion-installation: In the pilot plant there are exhaustion installation equipment (based on the project/firm Dr. Hesse) and two general exhaustors. No equipment for pressing of fresh air was installed. This equipment is very essential for the starting of cyanide baths.
6. Due to the lack of apparatus for pre-degreasing in trichlorethylene (work capacity e.g. 60x60x100 cm) it makes it impossible to remove grease and oil from parts which require electrolytical treatment and as a result these contaminate all successive baths in technological processes.
7. Refrigerator: Some of the electroplating baths, e.g. anodizing (max: $+18^\circ\text{C}$) bright copper plating (max: $+28^\circ\text{C}$), black chromium plating (max: $+24^\circ\text{C}$) require intensive cooling. In Cuban's climatic terms, the refrigerator may be indispensable now already for the stable work of bright copper plating bath.
8. Fillers to filters: Indispensable is the purchase of filter-fillers to possessed filters, which will make possible the filtration through activated carbon (current filtration of bright nickel bath and regeneration of other baths).

9. Generally all electroplating processes (specially modern processes with brighteners) require work to be carried out in a clean atmosphere, The pilot plant in CIME is localized close to a road, on which many times a day cars pass raising great amounts of dust. In Cuban's climatic conditions it is impossible to work with closed windows. It is suggested that this car passage should be closed.

10. Technical amper-hour-meters: The urgent purchase of 4-5 Ah-meters for direct current is required. Also the supplement of some materials and regeneration of baths must be corrected under their supervision.

B. LACKS MAKING NORMAL WORK DIFFICULT OR DANGEROUS IN THE FUTURE

It is impossible to carry out normal, continuous work due to the pauses (1-2 times a day) in the supply of current water and electrical current. The use of cyanide baths may be the casuse of dangerous successions, in other cases it makes the work difficult and causes increased shortages of raw materials. Ca 50% of every electroplating technology consists of rinsing operations.

C. EQUIPMENT POSSIBLE TO PURCHASE IN THE FUTURE

1. The corrosion investigations in natural atmospheres are fulfilled in 4 territory stations, which are indispensable for the development of the plant climate-conditioning cabins for corrosion investigations are very expensive. It is possible to use such cabins (clim.) in CIQ or (corr.) in CNIC on mutual contracts.

2. For technical purposes purchase in the future of (a) bowl for electroplating of small parts (details), (b) installation for the periodic change of direction of direct current ("P.R."), (c) apparatus for measuring of roughness of surface and after some years equipment for laboratory, scientific investigations such as: potentiostats and others will be indispensable.

The lack of equipment given in p.c.1.2 neither limits the work of the electroplating pilot plant, nor makes it difficult in the technological sense.

3. Careless execution of works and useful rationalization. The tank for chromium plating bath is connected to the exhauster in which is not installed the dropper of vapours. After finding of documentation, it ought to be installed in accordance with it.

In accordance with the equipment request and purchase from Dr. Hesse one-step rinsing tanks were supplied. The visible deficit of water will force the CIME in the future to adapt them for two-step rinsing tanks with compressed air. This adaptation is very simple and may be made using information received on lectures or using the book "CALWANOTECHNIKA" Vol.2, p.14 (app.5, p.23).

III. TRAINING

Immediately after arrival to Havana, I began elementary theoretical training of the personnel of CIME. The training determined the cycle of lectures which is given in app.3, p.III A 1-5. The list of participants of this training, with their scientific qualifications and posts is given in app.4.

Because it was not possible to lead parallel theoretical and practical training a working schedule was arranged for the remainder of the day, (after 12a.m.). The rest of the day was spent preparing posts and equipment indispensable for practical training (tests: in Hull and Gilmont-cells, measuring of internal stresses of metal coatings, measuring of thickness of the coatings, etc.).

The term "elementary" training is here consciously used because the theoretical material which in training of this kind in Poland includes in ca 120 hours was here condensed out of necessity to 48 hours, from which ca a half were used for translation.

Additional difficulties was the very different level of the people being trained (1 doctor, 1 engineer, 6 electroplating technicians, 2 chemical technicians, 1 manual worker). The trainees being trained were very interested in the training they were receiving. At the beginning 5 people participated in the training being given and by the end there were 11 people.

A relatively high level of theoretical knowledge to very low (for the understanding by the majority of the people being trained) practical was given.

In accordance with obliging local orders, all the personnel of plant utilized between 25-31.12.82 for vacation. In view of this as well as waiting for the materials required for practical training, the time was used by the expert for translation of general technical and analytical instructions and some of the important chapters of books from the Polish language into Spanish.

The text from the chapter "Security and hygiene in electroplating plants" ought to be given for medical inspection before it is used in order to ensure that all cases, names and concentrations of remedies are in accordance with Cuba's terminology and conditions.

Three copies of all documents translated into Spanish (81 pages of every copy) was given to the Director of CIME (app.5 p.1-11), for circulation to the immediate executors, the chief of the department, and for the Vice Director of CIME and reserved in case of necessity for additional multiplication. The last copy of translations are also full texts of general technological instructions in the Polish language for the case, however, it is suggested that the translations be compared.

Because Cuba does not have norms for corrosion investigations, the last copy was given to the Vice Director, of CIME, Mrs. Osmara Ortiz, who understands and speaks Polish (Polish Norms and other materials in Polish) as it was thought that these might be of use for the working of the plant.

Before the departure of the expert, all general, technological and analytical instructions were carried out by the personnel of CIME. Some of these will be difficult to use on account of great lacks in material in Cuba (e.g. bright copper plating bath) or temperatures difficult to maintain (bright copper plating and black chromium plating baths).

UNIDO Expert Prof. T. Zak during his stay in Cuba, Argentina and Mexico, stated that the technical literature on electroplating in Spanish is very poor. The writer also confirms the abovementioned statement to be true. In his opinion in the shortest time possible this should be remedied by acceptable translated and written book about electroplating methods at the engineer's level. It would be possible to make a contract with Poland and Cuba to carry this out.

IV. PREPARATORY WORKS

Parallel to the elementary theoretical training were done preparatory works. These works met with great obstacles in the presence of lack of materials. In accordance with the expert's proposition (app.3.p.III C.D.) the technical training doesn't include the problems of cyanide baths.

1. In the presence of lack of any brighteners and catalyzators used in modern electroplating baths, urgent delivery from IMP of these reagents were required, so that the bath could be introduced by periodic neutralization of effluents. The required materials arrived on 13.12.82 and were dispatched to CIME (app.5 p.20,21).
2. In the presence of lack of abrasive elements (disks) and panels for testing of baths and coverings, CIME workers made 12 disks covered with abrasive materials which were in CIME and made ca 200 testing panels.
3. From the PVC-linen received from IMP were made bags for different kinds of anodes.
4. The workers under the expert's supervision have projected, personally made and covered with isolation 10 models of jigs from steel and 20 from brass. By careful conservation (chiefly by isolation) it may be reserved for 1/2 - 1 year).
5. The workers made in its own range the neutralization of some baths and neutralizator's chambers from effluents accumulated there.
6. Almost all workers have made personally the tests of quality of electroplating baths and coverings which were received from these baths. The testing was made and delivered from IMP Hull and Gilmont cells (montage of post, measuring technic, interpretation of results).
7. Next were made laboratory tests of coverings of metals on pattern-panels in 3-liter containers before starting with the new baths in installed tanks (four kinds of baths according to the Polish patents and brighteners received from IMP. Such covered elements were utilized for measuring of thickness of metal coatings (for training), on CIME equipment and non-refundable delivered apparatus from Poland (app.5 p.2c).
8. Test for internal stress of metal covering was made as a display only once because with the standard equipment only 3 patterns were delivered. Preparation of own patterns (kind of steel, formation of special dimensions of patterns) must be made later.

V. INTRODUCTION OF NEW BATHS.

Three workers from the pilot plant in CIME (1 doctor and 2 engineers) have personally made, regenerated and transformed the existing baths in CIME for high-speed, modern electroplating baths according to the Polish patents (bright nickel and bright copper plating baths) and also introduced new technologies: bright zinc plating and chromium (decorative, hard and black) plating, according also to the Polish patents.

Until a final decision is made concerning neutralization of effluents in CIME the effluents from this bath may be periodically neutralized in the pilot plant, and after full precipitation from the injurious substances and after neutralization and filtration, sanitary effluents will be dissolved. Residues received after primary dehydratization ought to be gathered until the neutralizers are dissolved.

The introduction works were made as well as the introduction of four baths, their permanent control in Hull or Gilmont cells and measuring of thickness of coverings, received from these baths.

The work on introduced baths were carried on till the departure of the expert on 7.2.83 from Havana, by different workers of CIME.

VI. POSSIBILITY OF INTRODUCTION OF CYANIDE BATHS
in the electroplating pilot plant in CIME

For realization of the principal purpose of the programme which ought to serve the pilot plant in CIME (pilot plant for training and exhibitions based on modern technologies of covering of parts with metallic coatings, in the future: Centre of electroplating investigations) it would be indispensable for the plant to have pattern technologies based on cyanide baths (copper, zinc, cadmium plating, etc.).

In the expert's opinion beginning of work based on cyanide baths will be possible exclusively after:

- (1) Permitting through commission to the exploitation of neutralizer or another stable substitute solution for the neutralization of effluents, which must be installed based on full technical documentation.

- (2) Covering of the cyanide baths (walls, floor, effluent draws, etc.) with beton (concrete), doppel-asphalt, chemical resistant resin and ceramic plates, after separation of cyanide territory with beton (see p.II.A.2), thresholds.
- (3) If the commission permits the exploitation of all effluents canals, exhaustion, water and current installation in the electroplating pilot plant in CIME.
- (4) Installation of working exhausters for all tanks including cyanide or acid baths.
- (5) Building of cyanide magazine based on correct documentation (exhaustion, water, ceramic plates, (as above in point 2), double closed dorres, etc.
- (6) Protecting of satisfactory amount of cyanides and reagents for their neutralization minimum for three months.
- (7) Additional training of 2-3 engineers/technicians/workers of CIME for about 2 to 3 months in foreign countries in the range of cyanide baths (app.3 p.III.D). Such training ought to include the following:
 - preparation of cyanide baths, their conservation, exploitation, analysis and methods of neutralization.

If any of the above given points are not carried out, the introduction of electroplating technologies based on cyanide baths will be impossible.

VII. CONCLUSIONS

The lack of neutralizers of electroplating effluents and indispensable materials for preparing of cyanide baths for use in the pilot plant in CIME made it impossible to carry out the project according to the project requirements. To introduce technologies without proper neutralization of effluents additionally complicated this situation.

The lack of proper written information from the investor about the state of the plant made it necessary to have the job description changed to reflect the actual situation and to enable the expert to meet its requirements. (app.3. p.III)

If possible UNIDO should continue its assistance to CIME in order to carry out the recommendations and findings made by the expert in order to order to enable the pilot plant to be put into full use and operation. To do this the Government of Cuba will be required to recognize this investment as a priority for 2-3 years and to request UNDP/UNIDO's assistance for funds for equipment, training , etc. in order for the plant to be made full use of.

It is understandable that fundamental, short training of CIME workers will not make it possible for full utilization of the pilot plant without cyanide baths, therefore not making it possible for the project to reach its objectives and outputs.

Only one technology (black chromium plating) was demonstrated for because without tanks and refrigerator it would not be possible to effectively introduce new technologies for operation in the plant.

However, as a first step in the development of the plant, four of the principal non-cyanide technologies was put into operation. It will nevertheless be necessary for CIME to use the technologies introduced by the expert during his mission for current production in CIME for the industrial institutions in Havana or in the nearest neighbourhood which is the maximum possible it could carry out.

The workers ought to systematically work on these technologies and to acquire their own technological experiences till the plant is in full operation. The acquiring of a training manual would be beneficial.

In spite of the various different and great difficulties the range of utility of the pilot plant will be greater to its development. This activity will require great effort from the personnel, interest and help from the Direction of CIME, patronage and control of the Cuban Government.

In the first six months of 1983 all the technical workers of the pilot plant ought to master between two and five of the introduced technologies, and in the second half of 1983, the rest of them.

All four points of the expert's job description were fulfilled. The theoretical and practical training were fulfilled in the range possible and carried out according to the present possibilities of the pilot plant in CIME, without training in the range of cyanide baths. This fact has also earlier on been mentioned.

On the request of UNIDO's expert a conference on the subject of the future of the new electroplating pilot plant was held in which the following took part:-

Mr. Juan P. Vázquez - Vice Minister of Ministry of Metallurgy
and Mechanics.
Mr. Danilo Michel - Director of CIME
Mrs. Osmara Ortiz - Vice Director of CIME
Mr. Heriberto Ches - Chief of Department of electroplating in CIME
Zdzislaw Kolanko - UNIDO Expert for electroplating in Cuba.

At this conference detailed discussions (on the basis of this report) on all the problems of the pilot plant which were revealed during the expert's mission and development of the station in the future.

At this conference was also discussed the possibility of a new theme for UNIDO assistance in 1983/84, namely "Cathodic protection". There were detailed discussions on the advantages resulting from the access to this programme. The report from this conference is given as app.6.

VIII. RECOMMENDATIONS OF UNIDO EXPERT

1. After receiving a copy of this report the Direction of CIME ought to make a proposal to the Cuban Government requesting priority to be given to the further strengthening of this electroplating pilot plant in CIME for a 2-3 years period, to put in order all investments, provision of special training of 2-3 persons in other countries, and assurance of funds for covering of these expenses.
2. In the first six months of this year, based on the appropriate Government's entitlements, the Direction of CIME ought to complete all the lacks limiting the normal, current work of the pilot plant, which are given in point IIA 1-10, B and C3 of this final report.
3. The Direction of CIME through the mediation of appropriate Government agencies ought to apply immediately to UNIDO in Vienna with a request for further assistance to this project in order to solve all the given problems as well as considering the possibility for 2-3 persons to have training in other countries. These persons undertaking the training would require a knowledge of English and Russian. Training should be undertaken for 2-3 months in cyanide baths and these investigation methods would be of assistance as due to the lack of equipment and required apparatus, they are not able to acquire this knowledge in the plant.

4. In accordance with the programme for starting a pilot plant with cyanide baths, the Direction of CIME based on the appropriate Government's entitlements ought in 1984 to assure the performance of all works which are included in the Chapter VI of this report. These works ought to be performed based strictly on proper technical documentation and instructions. The start of cyanide baths ought to be coordinated with special training of CIME workers in other countries and on completion of it, they could immediately start the installation of cyanide baths in their country.

5. The Direction of CIME ought to use the present possibilities of the plant which have partial introduction of electroplating technologies in CIME and perform refundable electroplating works for industrial plants in Havana or the nearest neighbourhood.

5. For the further development of the electroplating pilot plant in CIME further UNIDO assistance will be required. In view of this it is suggested that UNIDO be kept informed of the progress of the plant and detailed information given to UNIDO on the type of continued assistance required.

ACKNOWLEDGEMENTS

The expert wishes to express his sincere thanks to the Direction of CIME for his friendly attitude to his mission and demonstrated technical and organizing helpfulness. Special warm thanks is given to V. Dir. CIME Mrs. Osmara Ortiz with whom he solved the most difficult, technical problems), for her enormous efforts, to solve in the short mission time most of the problems.

The expert also wishes to express his thanks to:

- Ms. Francia Allende for her organized help in arranging for his stay in Cuba;
- Ms. Grettel V. Hernández for her great effort made not only in translation of difficult technical texts, but also for the tendency to put to use as much as it was possible all technical sub-titles of translated texts;
- All Cuban colleagues from the electroplating pilot plant in CIME for the effort they made in adapting in a very short time even with all the lack of necessary materials to learn what they could about electroplating which will be the field of their activity for the better future of their country.

Special thanks is expressed to Mr. Frederick Lyons Resident Representative a.i. in Havana for his help and friendly attitude during my mission.

Havana, 1983, February the 7th

ZDZISLAW KOLANKO

Specification of Abbreviations used in this final report:

CIQ - Centro de Investigaciones Quimicas, Havana, CUBA.
CIME - Centro de Investigaciones Metalúrgicas, Havana, CUBA.
IM.' - Institute of Precision Mechanics, Warsaw, Poland.
CNIC - Centro Nacional de Investigaciones Cientificas, Havana, CUBA.

Currency relation to one US dollar (approximate values received from UNDP - Havana).

Cuban Peso (January): 1974 - 0,815; 1977- 0,825; 1980 - 0,722; 1983 - 0,8574;

German Federal Republic Deutch Mark (July 1976); 2,56-2,50

Switzerland Fr. (July 1982) : 2,12

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UNIDO - Investments

EQUIPMENT FOR LABORATORY AND PILOT PLANT FOR PROTECTIVE COATINGS.

No.	Equipment	Price DM (1975)
1	Hot Degreasing Bath.	1119 = ca US \$
1	Electrolytic Cleansing Bath.	1586 = ca US \$
9	Cold Rinsing Tank.	8701 = ca US \$
2	Acid Dipping Tank.	1420 = ca US \$
1	Cyanide Zinc Plating Bath.	1374 = ca US \$
1	Passivating Tank.	833 = ca US \$
1	Hot Water Rinsing Tank.	1734 = ca US \$
1	Cyanide Copper Plating Bath.	1945 = ca US \$
1	Acid Copper plating Bath.	1945 = ca US \$
2	Bright Nickel Plating Bath.	5184 = ca US \$
1	Chrome Plating Bath.	2551 = ca US \$
1	Drag Out Tank.	792 = ca US \$
1	Neutralizing Tank.	792 = ca US \$
1	Extracting Device.	14563 = ca US \$
	Spare Parts	1949 = ca US \$
2	Selenium Rectifiers.	4906 = ca US \$
2	Selenium Rectifiers.	3164 = ca US \$
1	Manual Pole Reverse Unit.	225 = ca US \$
2	Agitation.	786 = ca US \$
 SUB TOTAL		 55569 = ca US \$
	Freight charges as prepaid	4574,38 = ca US \$
 TOTAL		 60143,38 = = ca US \$ 24,057.36
25	Plastic Ball Valves and Component Parts.	1183 = ca US \$
	Air freight charges	147
 TOTAL		 1330 = ca US \$ 532
4	Filter Pumps and Spare Parts.	SF 10587 (1982)
	Air freight charges	SF 2000
 TOTAL		 SF 12587 = ca US \$5937, Total US\$ ca: 30,527

Prepared by: Mr. Alberto Victorero
Havana 14.01.1983

CIME - Investments

	<u>Cost(pesos)</u>	<u>US Dollars</u>	<u>Year</u>
Civil Engineering.	30 000		77-80
Effluents Storage Tanks.	4 900		79
Equipment Assembly.	5 000		78-80
Environment Sanitary Systems.	2 551		77-80
as: - local extraction;			
- axial extractors;			
- treatment of effluents.			
Purchasing of auxiliary equipment	5 000		77-82
as:			
1 pH-meter			
2 Equipment for measuring of covering thickness			
2 Laboratory multiple water-baths			
2 balances			
1 P-307 potentiometer			
1 M95 galvanometer			
TOTAL		<u>47,451 = ca US \$ 37,961</u>	

Prepared by: Mr. Alberto Victorero
Havana 14.01.1983

AV

Report of expert's mission during the period April 20
to May 4, 1978, in Havana.

1. The activity of the expert was prescribed in the job description of 5 April 1978.
2. The points a,b, and c of these activities were discussed rigorously with the Direction of the CIME, with UNIDO representative and with the Cuban State Committee of Economic Collaboration in Havana.
3. Every question in which the Cuban part were interested, were answered, as well as the matters which weren't clear enough for the Expert, in reference to civil buildings, installations of effluent treatment, the obtainment of the essential chemical products for the beginning of the work in the pilot plant.
 - Part of the documentation from Poland was delivered, in Polish (a booklet in four volumes titled "The recent works in electroplating", "Electroplating Handbook", drawings of rackings, conversion tables, books about thickness measuring, technological instructions, brighteners, indicators, chemical products which were received by airway in April 26, 1978 as a present from the Institute of Precision Mechanics for the CIME).
 - The expert offered information about the most modern and essential books and reviews in electroplating.
 - The training of the personnel of the future pilot plant installations was started giving training in relation to electroplating.
 - The expert proposed the training of four or five persons in Poland, taking into account, that nobody in CIME had received this training. The training should be done taking into consideration the work being done by the personnel of the plant. The approval of this proposal will be informed to UNIDC and the CIME after discussing with the Direction of I.M.P. in Warsaw.
4. The most important jobs to be done in the CIME are the following in this order:
 - a) Finishing of the buildings for effluent treatment.
 - b) Finishing of the civil buildings (floors, roofs, insulations, tile work to paint twice the walls with paint, chemically resistant finishing of the workshop for cyanide).
 - c) Finishing of the setting up of the installations canalization, electrical installations, installations of compressed air, the manufacture in the CIME of double stage rinsing tanks.
 - d) The supply of chemical products to pilot plant (the quantities and the purity grade were delivered to Mr. Israil Utset).
5. The date for beginning the jobs in the pilot installations was agreed conjunctly (CIME, the Expert, the UNIDC representative in Havana, the Representative of the Cuban State Committee of Economic Collaboration in Havana), for November 15th, 1978. It was agreed conjunctly in order to secure the information about the working in the Pilot Plant that the CIME will send the correspondent information to UNIDO during the last working days of the month.

Short information about the electroplating
pilot plant in C I M E

1) Present state:

A year ago the CIME had installed partially used equipment in the electroplating pilot plant and by means of which it was able to carry out fundamental non-cyanide baths, such as metal cleaning, Cu, Ni, Cr and Zn plating baths.

Their use was limited because of the building of effluents neutralizers being reduced due to lack of funds and also their inability to purchase expensive equipment.

The effluents neutralization of these baths will be possible only periodically and with considerable difficulties.

On account of this it was agreed that it was impossible to use cyanide baths in the pilot plant. No cyanides were therefore bought for Cu, Zn, Ca, Na, baths.

Instead of these technologies, substitutions were proposed for other non cyanides. Such propositions are possible of course, nevertheless, if the electroplating plant ought to be a pilot plant centre which could determine technical and scientific investigations on Cuba in the future if it is to serve as an "emergency service" for the Cuban factories in which there are imported electroplating technologies (also cyanide baths). In my opinion, the electroplaters in CIME ought not only to have a theoretical knowledge on the subject of cyanide baths, but should go into the matter also practically, make the acquaintance of their troubles which are only possible when exclusively done working with their own hands. This practical experience gained would be of more assistance to the working of the plant.

The present costs of building of neutralizers in CIME and purchases of equipment is already high and finishing term difficult in following.

In view of the above, the expert will not be able to strictly carry out the job description duties as the plant is not ready for starting.

2) Suggestions of UNIDO Expert:

- a) It is necessary to convene a council of interested persons in this theme (UNDP, a representative of the Cuban Government, CIME) and to discuss the present state of this problem.
- b) Because the UNIDO Expert is already in Cuba, it is necessary to begin the introduction of these substitute technologies which are possible to use by the periodical neutralization system of effluents as several journeys can not be envisaged due to the increase of operational costs.
- c) It is also necessary to begin the training (theoretically and practically) of the Cuban engineers, technicians and workers. This action does not limit the further activity between UNDP and Cuban Government. In the second part of this information UNIDO Expert has given in working schedule some propositions for his three months stay in Havana. Some of them were already realized during the last time.

- d) The interested persons ought to define the possibility (expenses and term) for finishing the building of neutralizers or find a substitute action for this problem.
- e) As a substitute solution may be used the Polish patents (the method for neutralization of effluents and equipment for this technology) with effectiveness of this method the above can fully assure the neutralization of effluents in pilot electroplating plant in CIME and the delivery of equipment could be surely multiplied more quickly than building of the neutralizers.
- f) Building of the neutralizer in CIME as well as the purchase of patent licenses in Poland are behind time. In my opinion, after introducing substitute technologies which are possible to use in CIME, and after elementary teaching of some CIME workers it would be necessary to use these technologies to the current production in CIME for industrial institutions in Havan for which it is only possible; or to step out (Cuban Government via UNDP to UNIDO Vienna) and request for additional special training of 2-3 CIME workers in Institute of Precision Mechanics in Warsaw in the range of cyanide baths and on unique, non available equipment in Cuba.

After returning to Cuba, these persons could introduce lacking cyanide baths and begin giving special additional teaching in the field of electroplating.

3. Proposed working schedule for the UNIDO Expert: Z. Kolanko from 18th November 1982 to 10th February 1983.

A. Elementary teaching of Cuban Engineers, technicians and workers in electroplating lectures.

1. a) Anodic and cathodic coatings	23.11.82
b) Principles of electrochemistry.....	23.11.82
c) Mechanical preparation of metal and alloy surfaces	23.11.82
d) physico-chemical preparation of metal and alloy surfaces	24.11.82
e) Manufacturing and insulation of trucks, barrels for electroplating	25.11.82
f) Chemical and electrochemical polishing of metals and alloys	25.11.82
2. a) Copper plating	30.11.82
b) Nickel plating	1.12.82
c) Chromium plating.....	2 + 7.12.82
- decorative (black and white) on aluminium and zanak alloys.	
- technical.	
3. a) Zinc plating	7.12.82
b) Cadmium plating	7.12.82
c) Chemical methods of metal deposition....	8.12.82
d) Anodizing of aluminium and its alloys....	9.12.82

4. a)	Technology of rinsing, water used in galvanic processes	14.12.82
b)	Neutralization and removing of waste water used in galvanic processes	15.12.82
c)	Properties of baths	16.12.82
d)	Destructive and non-destructive methods for measuring of coatings thickness	21.12.82
e)	Methods for determining adesion and porosity of coatings	22.12.82
f)	Corrosion resistance of coated parts	22.12.82
g)	Work protection and hygiene in plating shops	22.12.82
h)	Chemical analysis of electrolytes (quantitative and qualitative).....	23.12.82
5.	Methodology of development of galvanic coatings.....	24.12.82

The elementary teaching in the mentioned days includes 3 hours of lectures from 9 a.m. to 12 p.m.

18-24.12.82: General problems, formalities, working schedule, information about the present state of the pilot electroplating plant in CIME and preparing of short information in this matter for the Resident Representative of the UNDP.

23.11.-3.12.82: Preparing of:

- list of chemicals and help materials, which ought to be every time on the magazine for continuous work in the pilot plant;
- project of jigs (racks) for all the anodes and other different parts to perform them in the workshop before starting with using of the baths;
- solutions for metal cleaning, chemical and electro-chemical polishing of metals and their alloys;
- panels of steel (300) and brass (200) for testing of electroplating baths;
- translation into Spanish methods of analysis of Ni and Cu baths.
- A contact was made with IMP in Poland to send some brighteners for Cu, Ni-baths and catalysators for ore plating baths (because there were no other in CIME). These baths may be introduced in CIME by periodically neutralization, till the problem of neutralization of baths is solved.

6-11.12.82:

Teaching the Cuban engineers and technicians in the use of Hull-cell for:

- preparing of baths for Cu, Ni, Cr-plating, which will now be used;
- translations of bright copper plating bath analytical methods into Spanish.

13-17.12.82:

Teaching of thickness measuring of metal coatings on metals and their alloys (Cu, Ni, Cr and Cu or Ni, Cr on steel, Cu, Ni, Cr, and Cr on Brass and other metals) with the help of equipment installed in CIME.

Teaching of metal parts covering with Cu. Ni. Cr coatings.

20-25.12.82: Periodically neutralization of proposed introduction of baths, plating of metal parts with technical chromium covering.

B. On completion of the lectures (24.12.82) the remaining days will be used fully for plating of different parts with Cu.Ni.Cr-coverings, technical chromium electroplating, for measuring of thickness of these coverings, measuring of properties of the baths in Hull-cell, measuring of internal stresses of coatings for effluents treatment, etc.

In the expert's opinion 5 weeks (27.12 to 3.11.83) teaching of Cuban technicians it is possibly the shortest time in which they could go into the electroplating matter. In the last week of the UNIDO expert's stay in Cuba, he would handle all matters which are difficult to foresee at the moment.

C. The expert feel obliged to pay attention to his principals in view of the fact that the time proposed in the time schedule didnot include teaching the Cuban engineers, technicians and workers in the preparation and service of cyanide baths because it was not possible nor foreseen in the time before 10.11.83.

D. In the expert's opinion, it is not possible with such lacks in chemicals and other equipment and also the very great local difficulties in completing them to teach the Cuban technicians in cyanides and in a short time paralell to other technologies. It may be dangerous for the work in the future. To put the pilot plant (electroplating) plant into operation with cyanides in now not possible without previously teaching the Cuban technicians in other countries and training them in cyanide utilization after which the problem of cyanide baths and neutralization will be solved.

Appendix - 4

RELACION DE ASISTENTES AL CICLO DE CONFERENCIAS SOBRE RECUBRIMIENTOS GALVANICOS EN EL CIME (23 Noviembre - 24 Diciembre 1982

Profesor: Dr. Z. Kolanko.

Numero	Nombre	Nivel Técnico	Procedencia y Cargo.
1	Luis Nerey Carvajal	Licenciado Ciencias Químicas	Sustituto Dpto. Recubrimientos Metálicos CIME.
2	Jesús Manuel Silva.	Técnico Galvánico.	Polit. Ciudad Libertad Profesor.
3	Orlando Soto Ferreriro	Técnico Galvánico.	Polit. Ciudad Libertad Profesor.
4	Francisco Boulet Chacón	Operario Galvánico.	Operario de Planta Piloto CIME.
5	Iracl Zamora Utset.	Técnico Galvánico.	Técnico de Investigación CIME.
6	Rosario Paes Santana.	Técnico Químico.	Analista Químico CIME.
7	Haydee León González.	Técnico Químico.	Tecnólogo Químico CIME.
8	Alberto Benítez Gomez.	Técnico Galvánico	Técnico de Investigaciones CIME.
9	Santiago Ceballos Quintana	Técnico Galvánico.	Técnico de Investigaciones CIME.
10	Juan Bermúdez Torres.	Ingeniero Electrónico.	J' Planta Piloto Investigador CIME.

List of training materials received for CIME from Poland through the mediation of UNIDO-Expert.

I. Translations (into Spanish language, P - polish copy)
(copies: a - immediate executor; b - chief of dptmt;
c - Vdir. of CIME)

1. Admissible concentrations of contaminants in effluents before introducing them to the sanitary installation. - - - - -
2. Pattern of books: for preparation and preservation of electroplating baths, electroplating analysis, control of equipment and installations.-
3. Gener. Techn. Instr. Nr.45/67. Bright nickel plating bath KG-67. - - - - -
4. Analyse of bright nickel plating bath (Instr.) - -
5. Gener. Techn. Instr. Bright copper plating bath "Cu-177". - - - - -
6. Analyse of bright copper plating bath "Cu-177" (Instr.). - - - - -
7. Gener. Techn. Instr. Nr.115/80. Electrolytical chromium plating in the low concentration bath "Cr-80". - - - - -
8. Gener. Techn. Instr. Nr.116/80. Black chromium plating bath. - - - - -
9. Analyse of chromium plating baths (Instr.). - - -
10. Gener. Techn. Instr. Bright zinc plating in chloride bath. - - - - -
11. Security and hygiene in electroplating plants. (transl: Dr. O. Ortiz).- - - - -

Pages	Copies	Copies for		
		a	b	c
2	3	x	x	x
4	3	x	x	x
7	3	xP	xP	xP
7	3	x	x	x
7	3	x	x	xP
4	3	x	x	x
9	3	x	x	xP
6	3	x	x	xP
15	3	x	x	x
3	3	-	-	x
17	3	x	x	x
34	1	-	x	-
6	1	-	-	x
2	1	-	-	x

II. Additional materials in the Polish language:

12. J. Socha "Chromium Plating" (xerocopy from "Poradnik Galwanotechnik" p-s 147-176, diagrams, tables, illustrations). - - - - -
13. PN-67/M-04633. Testing of metallic protective coatings. Evaluation of results of corrosion... - - - - -
14. PN-68/H-04650. Classification of climates. Sorts of the execution of technical products. - - - - -

15. PN-71/H-04651. Corrosion protection. Classification and determination of corrosion aggressivity of environments. - - - - -	4	1	-	-	x
16. PN-80/H-97030. Corrosion protection. Electro-deposited and conversion coatings for tropics. - -	7	1	-	-	x
17. Instruction of Hoar's equipment for examination of internal stresses in electroplating coatings. -	11	1	-	-	x
18. Instruction Nr.07/60. Nickel plating in bowls. - -	8	1	-	-	x
19. Instruction Nr. 56/68. Electrolytical chromium plating in self-regulation bath. - - - - -	24	1	-	-	x

III. Moreover were displaced to CIME non-refundable delivered from Poland:

20. Brighteners for nickel, copper, chromium, zinc and black chromium electroplating baths (together 32 Kg).
21. Gilmont-cell and five Hull-cells for testing of baths and metal coatings received from them.
22. Electronic thickness-meter "Ultramet. A-52" Nr.1397/82 completely equiped (sound, three patterns, rectifier).
23. Seven technical books in the Polish language.
 - Praca zbiorowa "Galwanotechnika" Ed. CDOK-Warszawa. 1979 (4 vol.)
 - Biestek T., Sękowski S., "Methodology of measuring of metal coatings" Ed. PWN.W-Wa.
 - Sękowski S., "Equipment for measuring of coating thickness" IMP. BOLINTS (2 vol.)

Received from
UNIDO Expert

Chief of el.pl. dptmt:
Eng. Heriberto Casas
Havana 20.I.83

